aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Pneumatic Tie Rod Style Cylinders

Series VE for Valve Actuation

Parker

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With annual sales exceeding $10 billion, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. The company employs approximately 52,000 people in 48 countries around the world. Parker has increased its annual dividends paid to shareholders for 53 consecutive years, among the top five longest-running dividend-increase records in the S&P 500 index. For more information, visit the company's web site at http://www.parker.com, or its investor information site at http://www.phstock.com.

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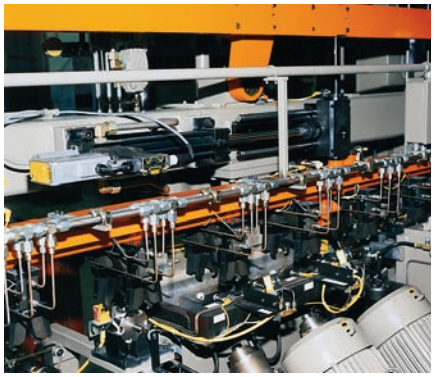
Parker Hannifin is the world's leading supplier of motion and control technologies that include; motion control products, systems, and complete engineered solutions for industrial markets. Parker's broad and extensive breadth of product



offer single source capability with limitless possibilities. Our Industrial product solutions range from state of the art stand-alone components to complete engineered systems that are designed to provide value and efficiency to all of our customers. Each component and system is backed up with superior application expertise and technical support that you would expect from Parker Hannifin.

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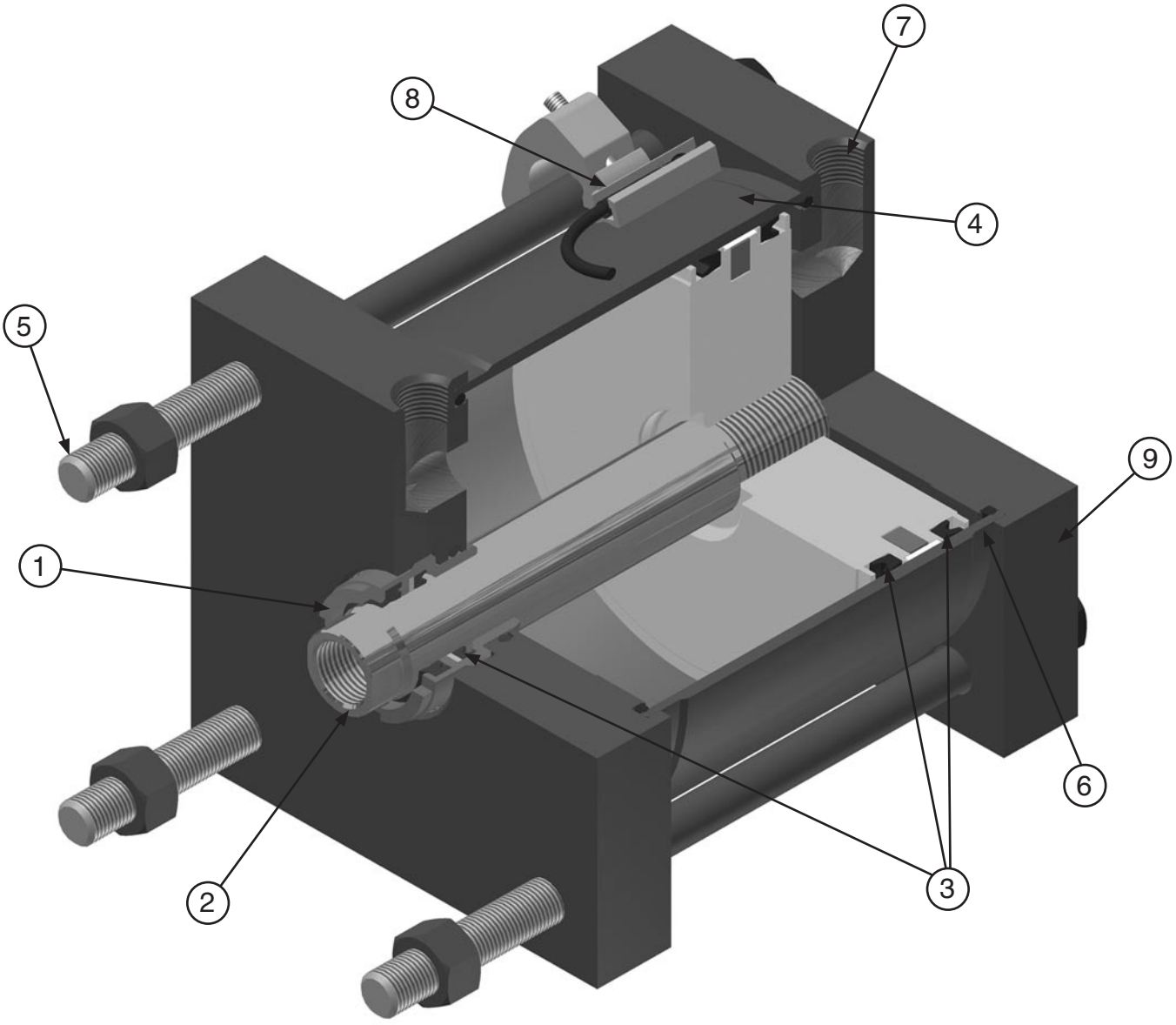
Parker Series VE
Pneumatic Tie Rod Cylinders



Parker Series VE Pneumatic Tie Rod Cylinders

Features Description

1. "Jewel" Rod Gland Assembly is externally removable without disassembling the cylinder. The "Jewel" rod gland incorporates a primary and secondary seal to assure leak-free service and longevity. The secondary seal acts as a rod wiper to prevent contamination from entering the cylinder. In addition, the secondary seal acts as a back up in the event of primary seal failure.

2. All piston rod assemblies utilize induction case hardened, medium carbon steel. All piston rods are hard chrome plated and polished to a 10 RMS surface finish. Each piston rod assembly comes standard with two wrench flats to facilitate rod end attachment.

3. Wear compensating lip seals are used throughout the rod gland and piston assembly to assure leak free operation and optimal performance over the life of the cylinder.

4. Cylinder body material options include steel with chrome plated I.D., aluminum, and composite to suit demanding application requirements.

5. All tie rods are made from high strength 100,000 psi minimum yield material.

6. Align-A-Groove design provides a 3/16" wide surface machined at each end of the cylinder body to assure tube to head alignment and leak free operation.

7. NPT ports are standard throughout the entire bore range.

8. Magnetic piston sensing option relays piston position throughout the entire stroke range. Solid state or reed switches are available with quick disconnect or flying lead terminations. This option is available on all bore sizes. Note: Wear band supplied with magnetic piston only.

9. Heads and caps are made from heavy duty steel and are machined to provide concentricity.

The Series VE cylinder provides OEM's and End Users a durable yet cost effective solution for knife gate valve actuation. Innovative options offer the ability to sense piston rod position, reduce weight, and increase corrosion resistance – resulting in improved system efficiency and reduced maintenance costs. Parker's utilization of cutting edge design systems, proven seal technology, the highest quality materials, and stringent quality standards assure reliable service in the most demanding applications.

Standard Specifications

- Bore Diameters – 2.00" to 24.00"
- Maximum Working Pressure – 150 PSI Pneumatic
- Piston Rod Diameters – .625" to 3.500"
- Stroke Lengths – Bore Diameter Dependant
- Single and Double Piston Rod Construction Available
- Spring Extend or Retract
- Double Acting

In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

Seal Class Table

Seal Classes	Typical Fluids	Temperature Range
1 - Standard Nitrile	Compressed Air (pneumatic)	-10°F (-23°C) to +165°F (+74°C)
4 - Optional (at extra cost) Low Temp Nitrile Seals	Compressed Air (pneumatic) Low Temperature	-50°F (-46°C) to +150°F (+66°C)
5 - Optional (at extra cost)[1] Fluorocarbon Seals	Compressed Air (pneumatic) High Temperature	-10°F (-23°C) to + 250°F (+121°C)

[1]Class 5 Seals are limited to bore diameters up to 14.00".

Cylinder Weight Chart

Bore Ø	Rod Ø	Weight at Zero Stroke with Steel Tube & Cast Iron Piston (lbs.)	Weight per in Stroke w/ Steel Tube & Cast Iron Piston (lbs.)	Weight at Zero Stroke with Aluminum Tube & Aluminum Piston (lbs.)	Weight per in Stroke w/ Aluminum Tube & Aluminum Piston (lbs.)	Weight at Zero Stroke with Composite Tube & Cast Iron Piston (lbs.)	Weight per in Stroke w/ Composite Tube & Cast Iron Piston (lbs.)
2.00	0.625	6.50	0.50	6.00	0.40	-	-
2.50	0.625	9.00	0.60	8.50	0.50	-	-
3.25	1.000	12.97	0.70	10.78	0.47	12.63	0.43
4.00	1.000	17.10	0.87	13.75	0.50	16.57	0.45
5.00	1.000	27.45	1.09	21.25	0.63	26.66	0.57
6.00	1.000	37.24	1.40	29.11	0.67	36.15	0.60
7.00	1.000	51.50	1.71	39.8	0.97	50.06	0.75
8.00	1.000	66.17	2.13	50.65	1.00	64.15	0.78
10.00	1.000	125.56	2.63	-	-	123.22	1.18
12.00	1.375	181.23	3.16	-	-	178.39	1.47
14.00	1.375	277.02	3.70	-	-	273.58	1.74
16.00	1.750	384.26	6.09	-	-	377.17	2.55
18.00	2.000	526.85	7.09	-	-	517.89	3.11
20.00	2.000	668.35	7.91	-	-	657.34	3.51
22.00	3.000	899.78	12.10	-	-	881.66	5.20
24.00	3.500	1295.20	14.99	-	-	1269.61	6.08

Cylinder Weight Chart

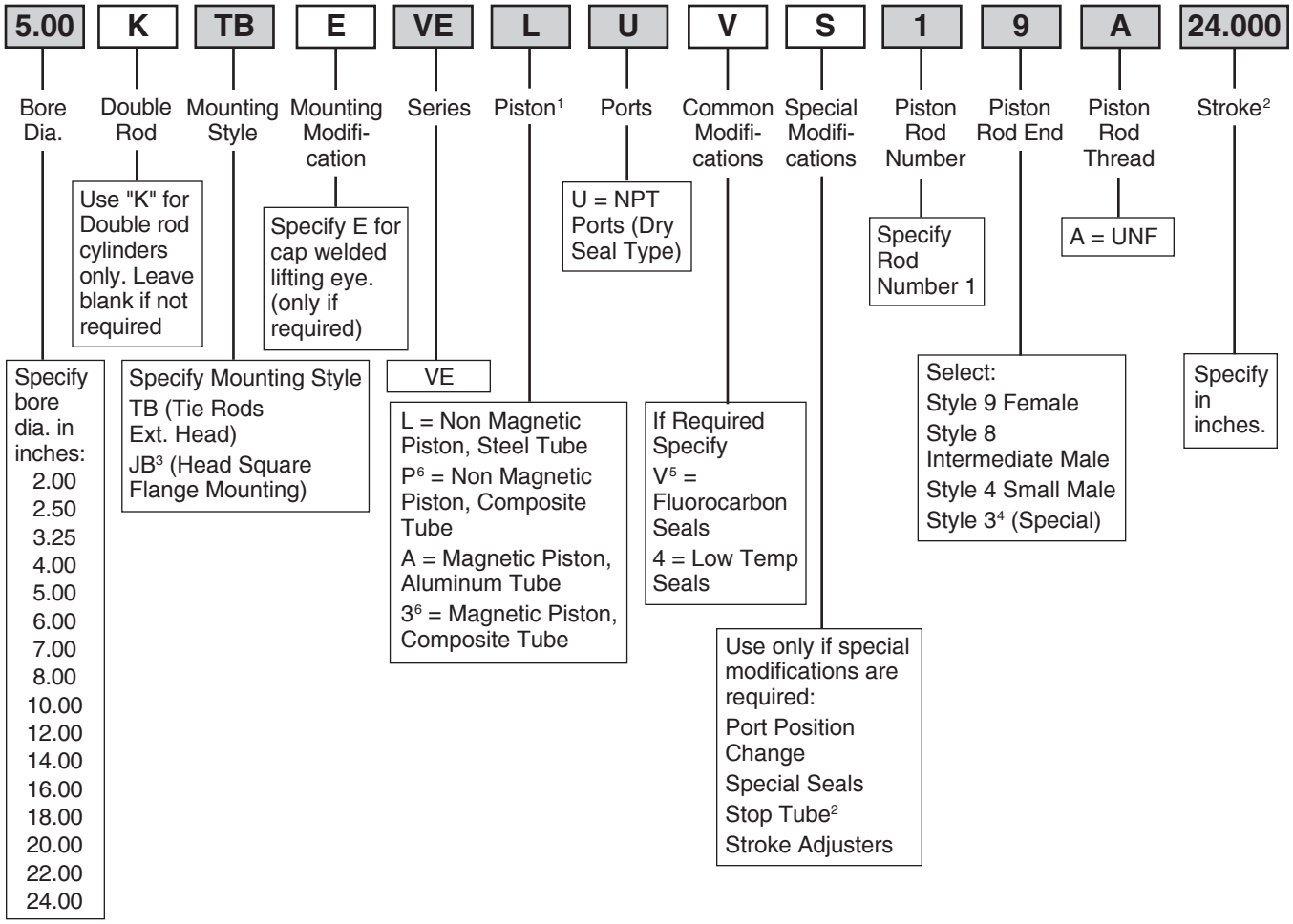
Bore Ø	Rod Ø	Weight at Zero Stroke with Composite Tube & Aluminum Piston (lbs.)	Weight per in Stroke w/ Composite Tube & Aluminum Piston (lbs.)
2.00	0.625	-	-
2.50	0.625	-	-
3.25	1.000	10.73	0.43
4.00	1.000	13.69	0.45
5.00	1.000	21.26	0.57
6.00	1.000	29.02	0.6
7.00	1.000	39.47	0.75
8.00	1.000	50.32	0.78
10.00	1.000	99.82	1.18
12.00	1.375	143.4	1.47
14.00	1.375	224.19	1.74
16.00	1.750	303.44	2.55
18.00	2.000	412.92	3.11
20.00	2.000	513.34	3.51
22.00	3.000	698.71	5.20
24.00	3.500	1031.15	6.08

Weight Adder Double Rod Cylinders

Bore Ø	Rod Ø	0" Stroke	Per Inch Adder
2.00	0.625	0.10	0.22
2.50	0.625	0.10	0.22
3.25	1.000	0.17	0.22
4.00	1.000	0.17	0.22
5.00	1.000	0.17	0.22
6.00	1.000	0.19	0.22
7.00	1.000	0.19	0.22
8.00	1.000	0.19	0.22
10.00	1.000	0.22	0.22
12.00	1.375	0.42	0.42
14.00	1.375	0.42	0.42
16.00	1.750	0.85	0.68
18.00	2.000	1.33	0.89
20.00	2.000	1.33	0.89
22.00	3.000	4.50	2.00
24.00	3.500	6.12	2.72

How to Order Series VE Air Cylinders for Valve Actuation

How to Order Code



Available Special Options

- Stainless Steel Piston Rods
- Spring Extend or Retract
- Double Rod End Style
- High Temperature Seals
- Water Service – consult factory for applications above 100°F (38°C)
- Lifting Eyes (welded on cap face)
- Stroke Adjuster (infrequent)
- Tie Rods Extended Head and Cap (Consult Factory)
- Low Temperature Nitrile Seals

Shaded boxes identify required model number fields.

[1] Lipseal Piston is Standard for all piston options.
The following lists standard tube and optional tube materials by bore diameter range with available piston codes:
L - Steel Tube is Standard for 2.00" - 8.00" bore (Non Magnetic Piston); Optional at extra cost 10.00" - 24.00"
P - Composite Tube is Optional for 3.25" - 8.00" (Non Magnetic Piston); Standard 10.00" - 24.00"
A - Aluminum Tube is Standard for 2.00" - 8.00" (Magnetic Piston); not available 10.00" - 24.00"
3 - Composite Tube is Optional for 3.25" - 8.00" (Magnetic Piston); Standard 10.00" - 24.00"

[2] If stop tube is required, please provide gross stroke length (gross stroke = stop tube + net stroke).

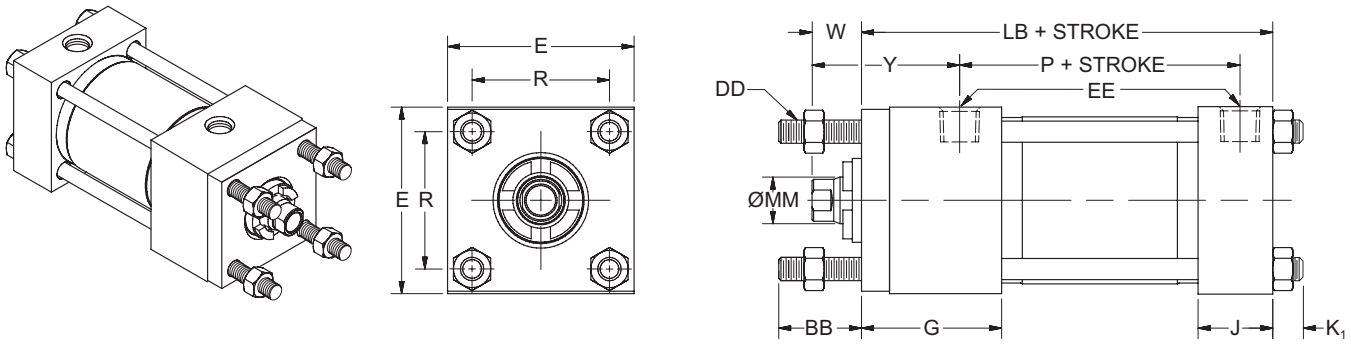
[3] JB Mount is available in bore diameters 7.00" through 20.00" only.

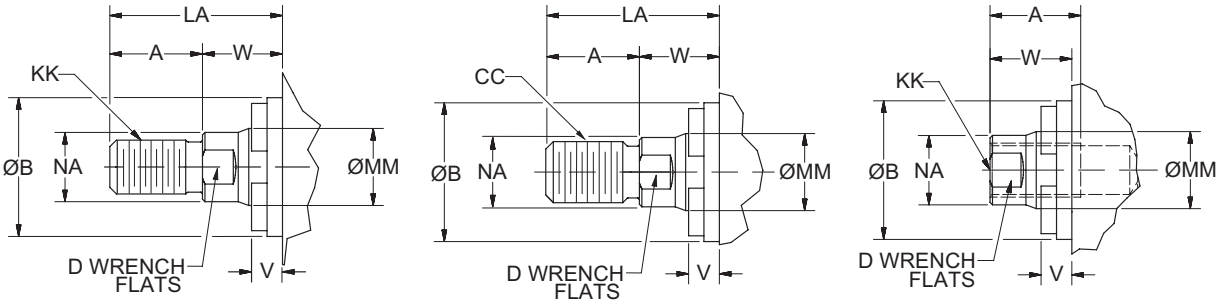
[4] Style #3 Rod End is deemed a “special”. When ordering, please supply KK, A and W Dimensions.

[5] Class 5 Seals are limited to bore diameters up to 14.00".

[6] Composite tubing is not to be exposed to fluids which have a pH level lower than 3 or higher than 11.

Cylinder Dimensions 2.00" - 2.50"





Style 4 – Small Male **Style 8 – Intermediate Male** **Style 9 – Female**

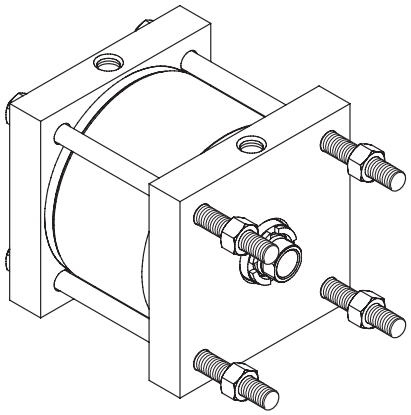
Cylinder Dimensional Table

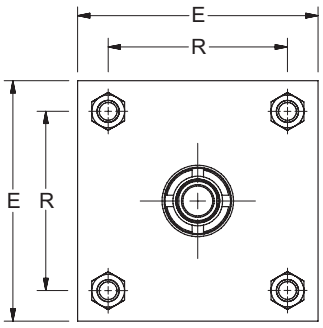
Bore Ø	MM Rod Ø	BB	DD	E	EE (NPTF)	G	J	K_1	R	Y	Add Stroke		Max Stroke
											LB	P	
2.00	0.625	1.13	5/16-24	2.50	1/4	1.88	1.00	0.44	1.84	1.94	4.00	2.25	60"
2.50	0.625	1.13	5/16-24	3.00	1/4	1.88	1.00	0.44	2.19	1.94	4.13	2.38	50"

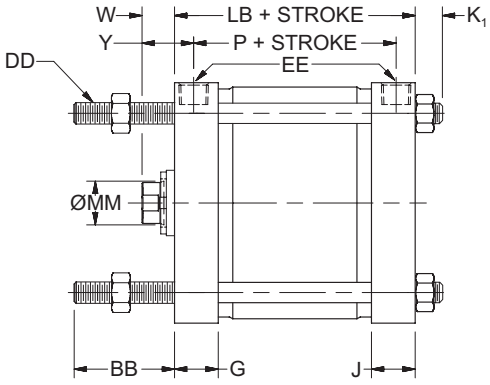
Rod End Dimensional Table

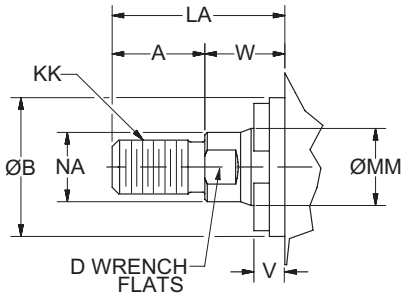
Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
2.00	0.625	7/16-20	1/2-20	7/16-20	0.75	1.124	0.50	1.38	0.56	0.25	0.63
2.50	0.625	7/16-20	1/2-20	7/16-20	0.75	1.124	0.50	1.38	0.56	0.25	0.63

Cylinder Dimensions 3.25" - 8.00"

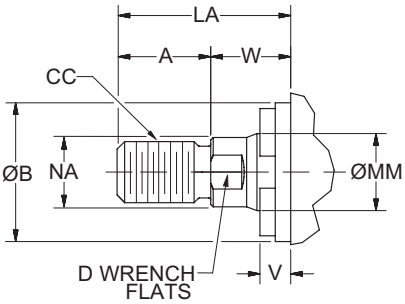




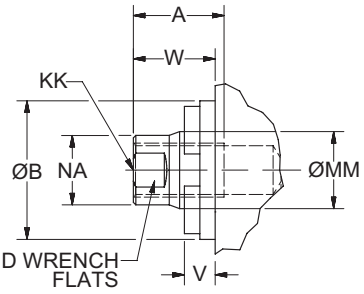




Style 4 – Small Male



Style 8 – Intermediate Male



Style 9 – Female

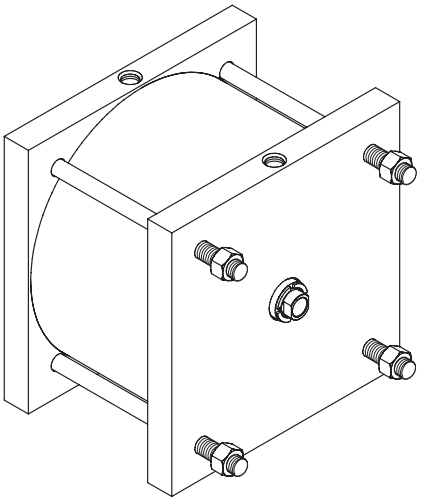
Cylinder Dimensional Table

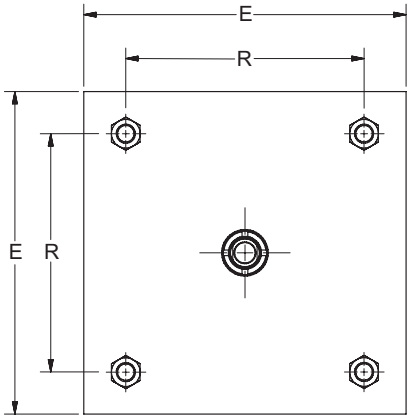
Bore Ø	MM Rod Ø	BB	DD	E	EE (NPTF)	G	J	K_1	R	Y	Add Stroke		Max Stroke
											LB	P	
3.25	1.000	1.38	3/8-24	4.00	1/4	1.00	1.00	0.50	2.76	1.19	3.25	2.38	100"
4.00	1.000	1.38	3/8-24	4.50	3/8	1.00	1.00	0.50	3.32	1.19	3.25	2.38	80"
5.00	1.000	1.81	1/2-20	5.50	3/8	1.00	1.00	0.63	4.10	1.19	3.50	2.63	65"
6.00	1.000	1.81	1/2-20	6.50	3/8	1.00	1.00	0.63	4.88	1.31	3.38	2.50	55"
7.00	1.000	2.00	5/8-18	7.50	3/8	1.00	1.00	0.75	5.73	1.31	3.50	2.63	45"
8.00	1.000	2.00	5/8-18	8.50	3/8	1.00	1.00	0.75	6.44	1.31	3.50	2.63	40"

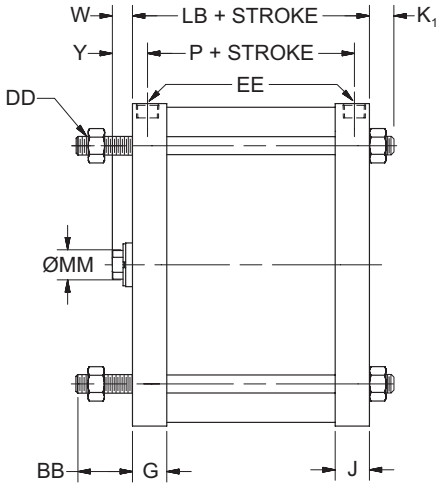
Rod End Dimensional Table

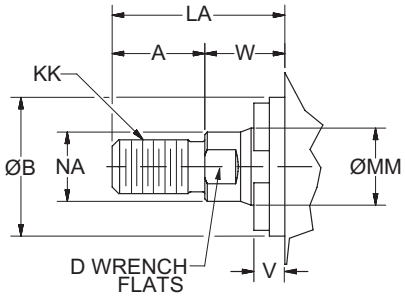
Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
3.25	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	1.88	0.94	0.31	0.75
4.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	1.88	0.94	0.31	0.75
5.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	1.88	0.94	0.31	0.75
6.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
7.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
8.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88

Cylinder Dimensions 10.00" - 24.00"

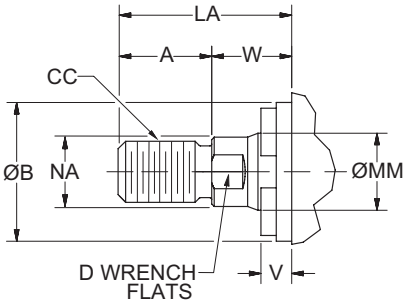




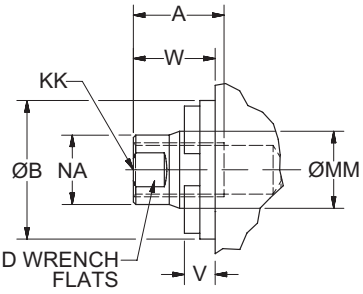




Style 4 – Small Male



Style 8 – Intermediate Male



Style 9 – Female

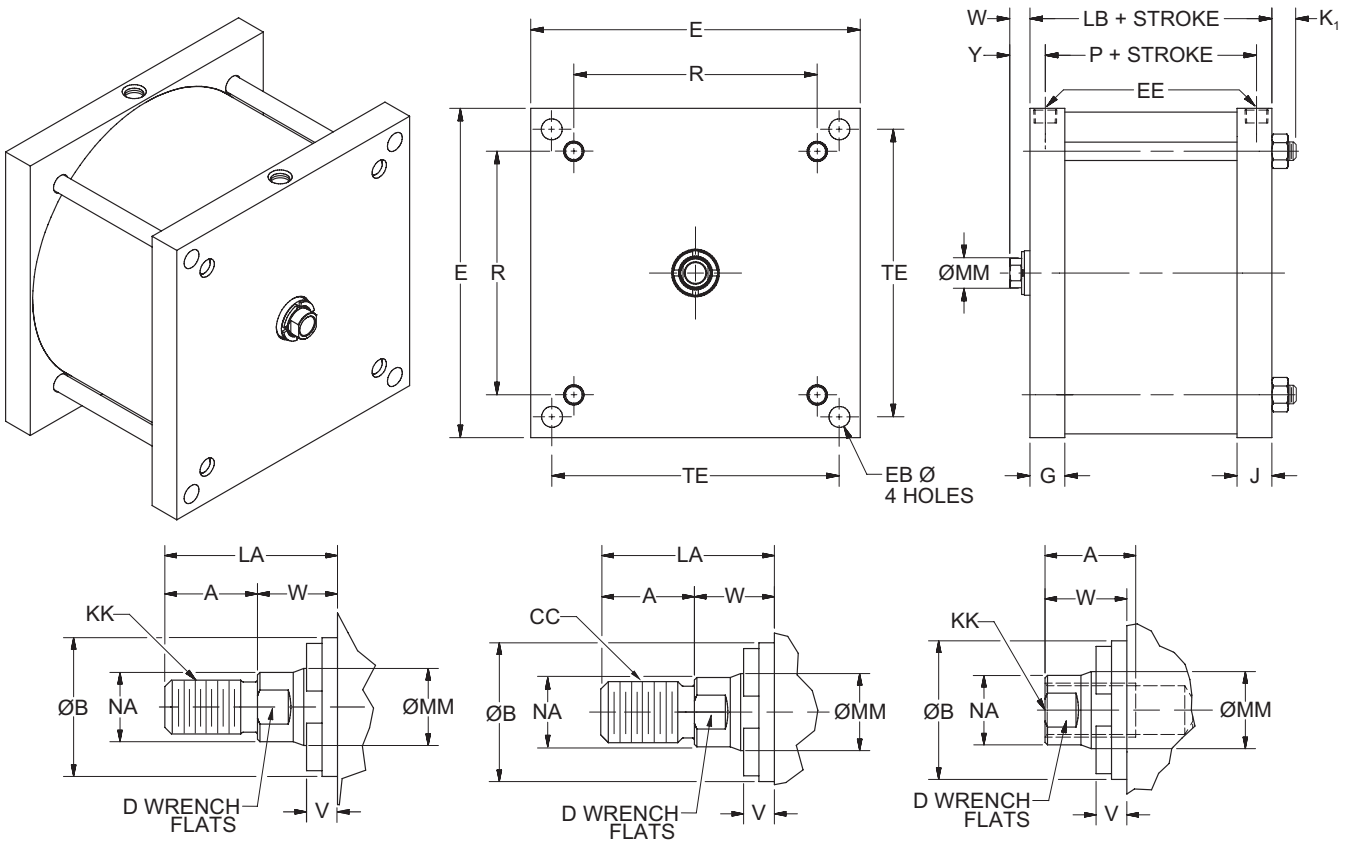
Cylinder Dimensional Table

Bore Ø	MM Rod Ø	BB	DD	E	EE (NPTF)	G	J	K_1	R	Y	Add Stroke		Max Stroke
											LB	P	
10.00	1.000	2.25	3/4-16	10.63	1/2	1.31	1.31	0.88	7.92	1.56	4.25	3.13	30"
12.00	1.375	2.25	3/4-16	12.75	1/2	1.31	1.31	0.88	9.40	1.56	4.31	3.19	50"
14.00	1.375	2.50	7/8-14	14.75	3/4	1.56	1.56	1.00	10.90	1.69	4.88	3.50	40"
16.00	1.750	2.75	1-14	17.00	3/4	1.56	1.56	1.13	12.59	1.94	5.13	3.75	60"
18.00	2.000	3.25	1 1/8-12	19.00	3/4	1.69	1.69	1.25	14.14	2.19	5.63	4.25	70"
20.00	2.000	3.25	1 1/4-12	21.00	3/4	1.69	1.69	1.38	15.77	2.19	5.88	4.50	65"
22.00	3.000	3.50	1 1/4-12	23.00	3/4	1.94	1.94	1.38	17.18	3.06	6.50	4.88	60"
24.00	3.500	3.50	1 1/4-12	25.25	3/4	2.44	2.44	1.38	18.74	3.56	7.75	5.13	60"

Rod End Dimensional Table

Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
10.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.13	0.94	0.38	1.00
12.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
14.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
16.00	1.750	1 1/4-12	1 1/2-12	1-14	1.63	2.374	1.50	2.88	1.69	0.50	1.25
18.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50
20.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50
22.00	3.000	2 1/4-12	2 3/4-12	2 1/4-12	3.50	3.749	2.63	5.75	2.88	0.63	2.25
24.00	3.500	2 1/2-12	3 1/4-12	2 1/2-12	3.50	4.249	3.00	5.75	3.38	0.63	2.25

Cylinder Dimensions 7.00" - 20.00"



Style 4 – Small Male **Style 8 – Intermediate Male** **Style 9 – Female**

Cylinder Dimensional Table

Bore Ø	MM Rod Ø	E	EB	EE (NPTF)	G	J	K_1	R	TE	Y	Add Stroke		Max Stroke
											LB	P	
7.00	1.000	7.50	0.56	3/8	1.00	1.00	0.75	5.73	6.75	1.31	3.50	2.63	45"
8.00	1.000	8.50	0.69	3/8	1.00	1.00	0.75	6.44	7.57	1.31	3.50	2.63	40"
10.00	1.000	10.63	0.81	1/2	1.31	1.31	0.88	7.92	9.40	1.56	4.25	3.13	30"
12.00	1.375	12.75	0.81	1/2	1.31	1.31	0.88	9.40	11.10	1.56	4.31	3.19	50"
14.00	1.375	14.75	0.94	3/4	1.56	1.56	1.00	10.90	12.87	1.69	4.88	3.50	40"
16.00	1.750	17.00	1.06	3/4	1.56	1.56	1.13	12.59	14.85	1.94	5.13	3.75	60"
18.00	2.000	19.00	1.19	3/4	1.69	1.69	1.25	14.14	16.69	2.19	5.63	4.25	70"
20.00	2.000	21.00	1.31	3/4	1.69	1.69	1.38	15.77	18.46	2.19	5.88	4.50	65"

Rod End Dimensional Table

Bore Ø	MM Rod Ø	Style 4 KK	Style 8 CC	Style 9 KK	A	B Ø +.000 -.002	D	LA	NA	V	W
7.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
8.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.00	0.94	0.38	0.88
10.00	1.000	3/4-16	7/8-14	3/4-16	1.13	1.499	0.88	2.13	0.94	0.38	1.00
12.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
14.00	1.375	1-14	1 1/4-12	1-14	1.63	1.999	1.13	2.63	1.31	0.38	1.00
16.00	1.750	1 1/4-12	1 1/2-12	1-14	1.63	2.374	1.50	2.88	1.69	0.50	1.25
18.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50
20.00	2.000	1 1/2-12	1 3/4-12	1 1/2-12	2.25	2.624	1.69	3.75	1.94	0.56	1.50

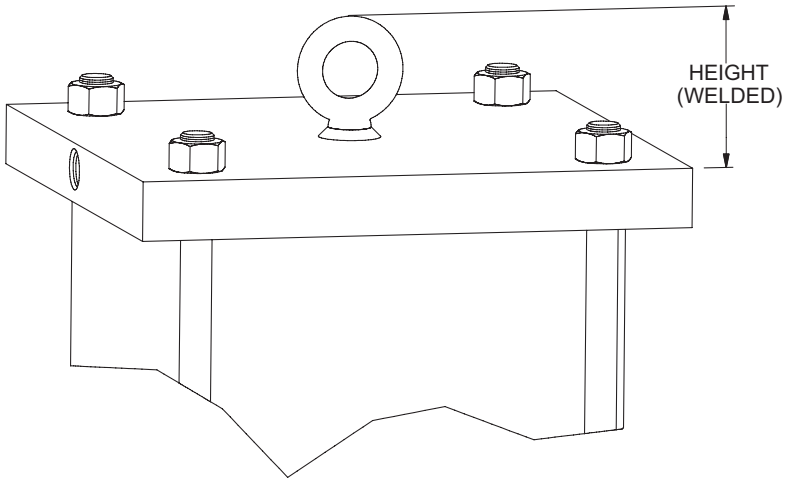


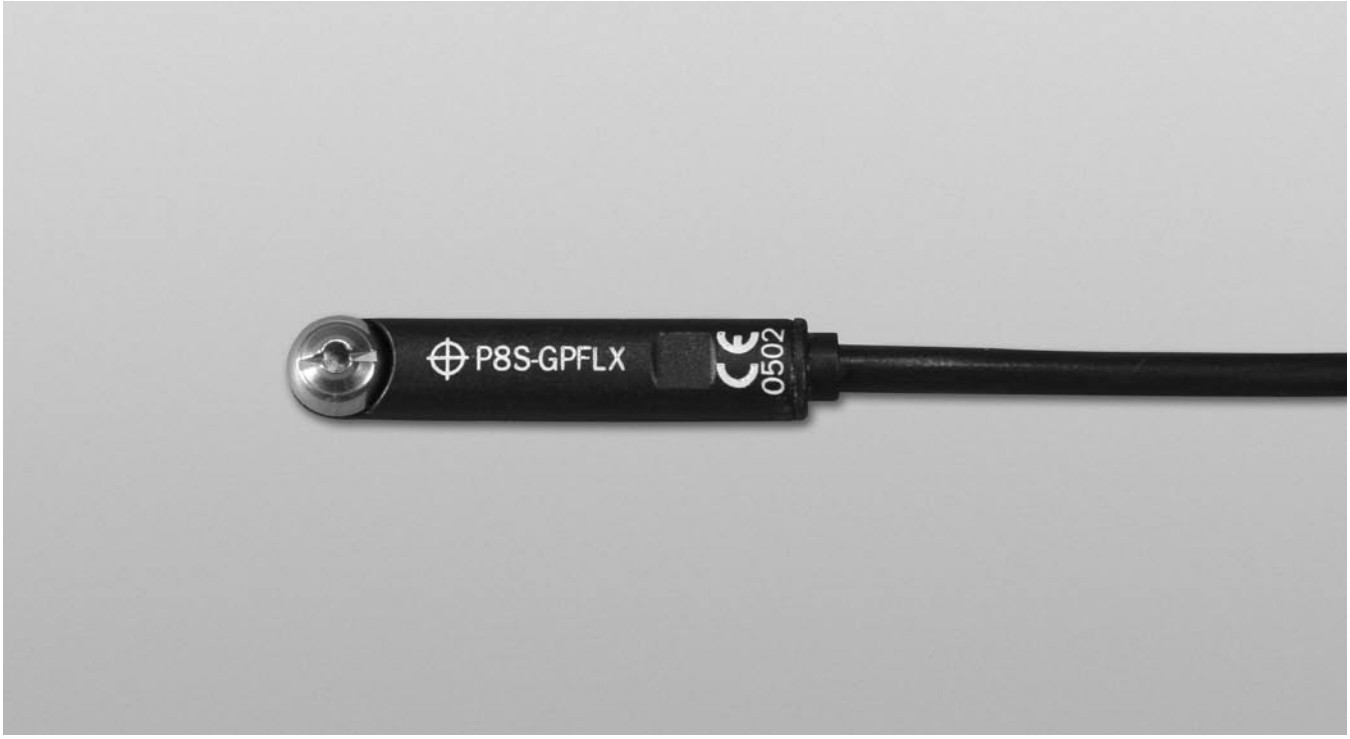
Table 1 – Lifting Eyes

Bore Ø	Welded Lifting Eye Height	Welded Lifting Eye Capacity (lbs. per eye)
2.00	1.63	500
2.50	1.63	500
3.25	3.19	2000
4.00	3.19	2000
5.00	3.19	4000
6.00	3.19	4000
7.00	3.19	4000
8.00	3.19	4000
10.00	3.19	4000
12.00	3.19	4000
14.00	3.19	4000
16.00	3.19	4000
18.00	3.19	4000
20.00	3.19	4000
22.00	3.19	4000
24.00	3.19	4000

Table 2 – Tie Rod Torque

Bore Ø	Tie Rod Size (inches)	Tie Rod Nut Torque Steel Tube		Tie Rod Nut Torque Aluminum Tube		Tie Rod Nut Torque Composite Tube	
		ft. lbs.	N-m	ft. lbs.	N-m	ft. lbs.	N-m
2.00	5/16-24	12	16	6	8	-	-
2.50	5/16-24	12	16	6	8	-	-
3.25	3/8-24	25	34	18	24	13	17
4.00	3/8-24	25	34	18	24	13	17
5.00	1/2-20	60	81	37	50	30	41
6.00	1/2-20	60	81	37	50	30	41
7.00	5/8-18	90	122	60	81	55	75
8.00	5/8-18	110	149	60	81	55	75
10.00	3/4-16	148	201	-	-	78	106
12.00	3/4-16	172	233	-	-	78	106
14.00	7/8-14	275	373	-	-	118	160
16.00	1-14	390	529	-	-	250	339
18.00	1 1/8-12	540	732	-	-	350	475
20.00	1 1/4-12	745	1010	-	-	450	610
22.00	1 1/4-12	745	1010	-	-	500	678
24.00	1 1/4-12	745	1010	-	-	500	678

Global Position Sensing Switches



- Low Profile Keeps Switch Within Cylinder Envelope
- Both Reed and Solid State Switch Versions
- Switches Available World-Wide
- Solid State Switches use GMR Technology
- 5 Different Connection Styles
- Allow Position Sensing Anywhere Along Cylinder Stroke
- CE Approved

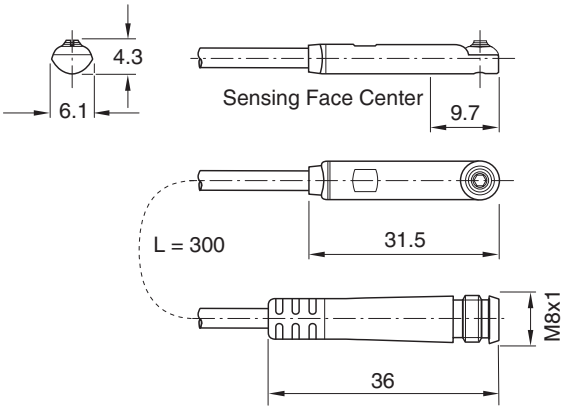
Global Drop-In Solid State Switches

Wiring	PNP Switch	NPN Switch	PNP Switch ATEX Certified
3m Flying Leads	P8S-GPFLX	P8S-GNFLX	P8S-GPFLX/EX[1]
10m Flying Leads	P8S-GPFTX	P8S-GNFTX	N/A
0.3m Lead with 8mm Connector	P8S-GPSHX	P8S-GNSHX	
0.3m Lead with 12mm Connector	P8S-GPMHX	P8S-GNMHX	
1m Lead with 8mm Connector	P8S-GPSCX	P8S-GNSCX	

[1]ATEX switch is supplied with 2m Flying Leads.

Specifications

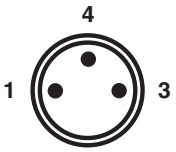
Switch Classification	Standard PNP or NPN	ATEX Certified PNP
Type	Electronic	
Output Function	Normally Open	
Switch Output	PNP/NPN	PNP
Operating Voltage	10 - 30VDC	18 - 30VDC
Continuous Current	100 mA max.	70 mA max.
Response Sensitivity	28 Gauss min.	
Switching Frequency	1kHz	
Power Consumption	10 mA max.	
Voltage Drop	2.5 VDC max.	
Ripple	10% of Operating Voltage	
Hysteresis	1.5 mm max.	
Repeatability	0.1 mm max.	
EMC	EN 60 947-5-2	
Short-circuit Protection	Yes	
Power-up Pulse Suppression	Yes	
Reverse Polarity Protection	Yes	
Enclosure Rating	IP68	
Shock and Vibration Stress	30g, 11 ms,10 to 55Hz, 1 mm	
Operating Temperature Range	-25°C to +75°C (-13°F to +167°F)	-20°C to +45°C (-4°F to +113°F)
Housing Material	PA 12 Black	
Connector Cable	PVC	
Connector	PUR	–
Approval for ATEX	–	3D/3G



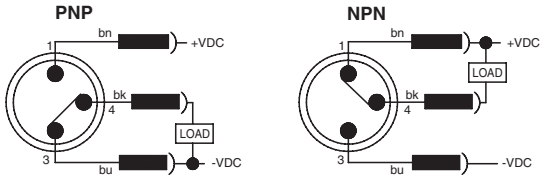
Global solid state switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

Solid State Switch Wiring Connection

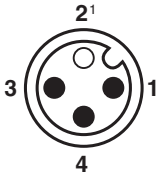
Flying Lead or 8 mm Connector (shown)



Pin	Wire	Function
1	Brown	Operating Voltage (+VDC)
4	Black	Output signal (N.O.)
3	Blue	-VDC

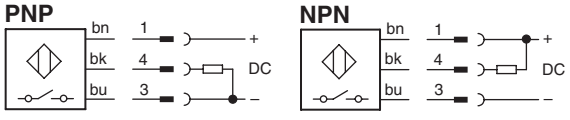


12 mm Connector



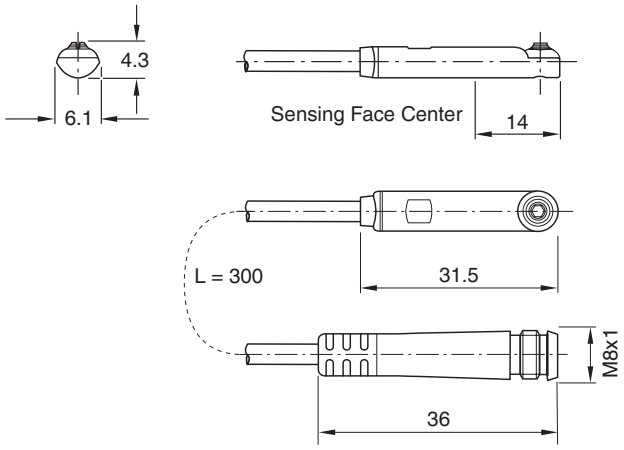
Pin	Wire	Function
1	Brown	Operating Voltage (+VDC)
4	Black	Output Signal (N.O.)
2[1]	White	Not Used
3	Blue	-VDC

[1]Pin 2 not present.



Global Drop-In Reed Switches

Wiring	Reed Switch
3m Flying Leads	P8S-GRFLX
10m Flying Leads	P8S-GRFTX
0.3m Lead with 8mm Connector	P8S-GRSHX
0.3m Lead with 12mm Connector	P8S-GRMHX
1m Lead with 8mm Connector	P8S-GRSCX



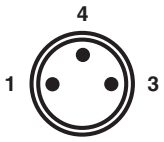
Specifications

Type.....2-Wire Reed
Output Function.....Normally Open
Operating Voltage.....10 - 120 VAC[1]
10 - 30 VDC
Switching Power.....6 W/VA
Continuous Current.....100 mA max.
Response Sensitivity.....30 Gauss min.
Switching Frequency.....400 Hz
Voltage Drop.....2.5 V max.
Ripple.....10% of Operating Voltage
Hysteresis.....1.5 mm max.
Repeatability.....0.2 mm max.
EMC.....EN 60 947-5-2
Reverse Polarity Protection.....Yes
Enclosure Rating.....IP 68
Shock and Vibration Stress.....30g, 11 ms, 10 to 55 Hz, 1 mm
Operating Temperature Range.....-25°C to +75°C (-13°F to 167°F)
Housing Material.....PA 12, Black
Connector Cable.....PVC
Connector.....PUR cable with 8 or
12 mm connector

Global Reed Switch output may be influenced by external magnetic fields. Care must be taken to avoid external magnetic field exposure. See Parker Industrial Cylinder Catalogs and Cylinder Safety Guide 0800.01-T1 for additional product application information.

Reed Switch – Wiring Connection

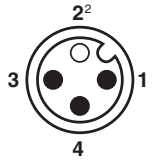
Flying Lead or 8 mm Connector[1]



Pin	Wire	Function
1	Brown	Operating Voltage (+V)
4	Black	Not Used
3	Blue	Output Signal (-V or Ground)

[1]8mm connector rated for 50 VAC max.

12 mm Connector



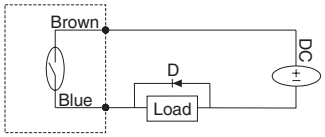
[2]Pin 2 not present.

Pin	Wire	Function
1	Brown	Operating Voltage (+V)
2[2]	White	Not Used
3	Blue	Output Signal (-V or Ground)
4	Black	Not Used

Circuit for Switching Contact Protection (Inductive Loads)

(Required for proper operation 24V DC)

Put Diode parallel to loads following polarity as shown below.



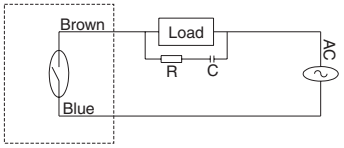
D: Diode: select a Diode with the breakdown voltage and current rating according to the load.

Typical Example—100 Volt, 1 Amp Diode
CR: Relay coil (under 0.5W coil rating)

(Recommended for longer life 125 VAC)

Put a resistor and capacitor in parallel with the load. Select the resistor and capacitor according to the load.

Typical Example:
CR: Relay coil (under 2W coil rating)
R: Resistor 1 KΩ - 5 KΩ, 1/4 W
C: Capacitor 0.1 μF, 600 V



⚠ Caution

– Use an ampmeter to test reed switch current. Testing devices such as incandescent light bulbs may subject the reed switch to high in-rush loads.

– **NOTE:** When checking an unpowered reed switch for continuity with a digital ohmmeter the resistance reading will change from infinity to a very large resistance (2 M ohm) when the switch is activated. This is due to the presence of a diode in the reed switch.

– Anti-magnetic shielding is recommended for reed switches exposed to high external RF or magnetic fields.

– The magnetic field strength of the piston magnet is designed to operate with our switches. Other manufacturers' switches or sensors may not operate correctly in conjunction with these magnets.

– Use relay coils for reed switch contact protection.

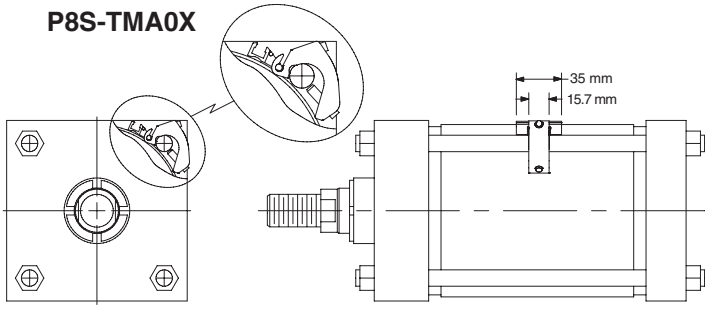
– The operation of some 120 VAC PLC's (especially some older Allen-Bradley PLC's) can overload the reed switch. The switch may fail to release after the piston magnet has passed. This problem may be corrected by the placement of a 700 to 1K OHM resistor between the switch and the PLC input terminal. Consult the manufacturer of the PLC for appropriate circuit.

– Switches with long wire leads (greater than 15 feet) can cause capacitance build-up and sticking will result. Attach a resistor in series with the reed switch (the resistor should be installed as close as possible to the switch). The resistor should be selected such that R (ohms) >E/0.3.

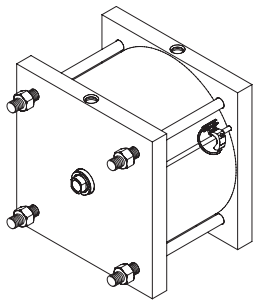
Tie Rod Bracket Assembly Part Number and Dimensions

Global switch bracket fits 2.00"-24.00" bore cylinders. Cylinder bore sizes 2.00" through 12.00" do not incorporate an extra tie rod for switch mounting. Bore sizes 14.00" through 24.00" utilize a fifth tie rod to facilitate switch mounting. Please note the standard location of this tie rod as depicted below. For alternate locations, please consult factory. Global switches and bracket assembles must be ordered separately.

P8S-TMA0X



2.00" - 12.00" Bore



14.00" - 24.00" Bore

8mm and 12mm Cordset for Global Switches

A female connector is available for all switches with the male 8mm and 12mm quick connect option. The cordsets are available with a right angle or straight connector. Cordset part numbers are listed below.

8mm Cordset

Cable Length	Threaded Connector	Snap On Connector
5 meters	086620T005	086620S005
2 meters	086620T002	086620S002

12mm Cordset

Cable Length	Threaded Connector	Right Angle Connector
5 meters	9126487205	9126487305
2 meters	9126487202	9126487302

Cordset Specifications

Connector.....Oil resistant polyurethane body material, PA 6 (Nylon) contact carrier, spacings to VDE 0110 Group C, (150 AC/DC)

Contacts.....Gold plated beryllium copper, machined from solid stock

Coupling Method.....Snap-Lock or chrome plated brass nut

Cord Construction .....Oil resistant black PUR jacket, non-wicking, non-hygroscopic, 300V. Cable end is stripped and tinned.

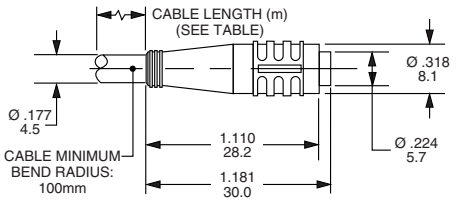
Conductors.....Extra high flex stranding, PVC insulation

Temperature.....-40 to 194°F (-40 to 90°C)

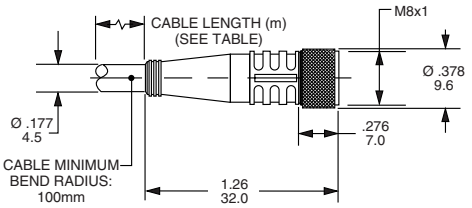
Protection.....NEMA 1, 3, 4, 6P and IEC 1P67

Cable Length.....6.56 ft (2m) or 16.4 ft (5m)

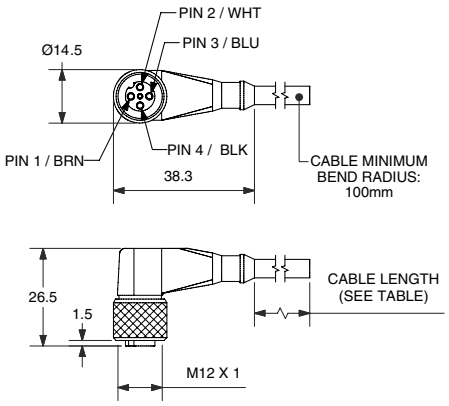
8mm Snap-On Straight Connector



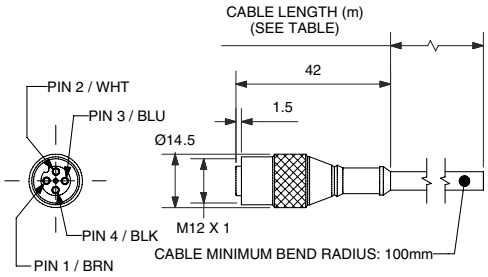
8mm Threaded Straight Connector



12mm Right Angle Connector



12mm Straight Connector



Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: ⚠ FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:

- **Unanticipated or uncontrolled movement of the cylinder or objects connected to it.**
- **Falling of the cylinder or objects held up by it.**
- **Fluid escaping from the cylinder, potentially at high velocity.**

THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.

Before selecting or using Parker Hannifin Corporation (the Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using the Company's products.

1.0 General Instructions

1.1 Scope – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

1.2 Fail Safe – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

1.3 Distribution – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use the Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

1.4 User Responsibility – Due to very wide variety of cylinder applications and cylinder operating conditions, the Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to the Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

1.5 Additional Questions – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-847-298-2400, or go to www.parker.com, for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

2.1 Seals – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

2.2 Piston Rods – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

2.3 Cushions – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be review by our engineering department.

2.4 Cylinder Mountings – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

2.5 Port Fittings – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure x effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.

3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

3.1.3 – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

3.2 Mounting Recommendations

3.2.1 – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

3.2.2 – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

3.2.3 – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

3.2.4 – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

3.2.5 – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

3.2.6 – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

4.1 Storage – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

4.1.1 – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

4.1.2 – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

4.1.3 – Port protector plugs should be left in the cylinder until the time of installation.

4.1.4 – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

4.1.5 – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

4.2 Cylinder Trouble Shooting

4.2.1 – External Leakage

4.2.1.1 – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland wear. If clearance is excessive, replace rod bushing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

4.2.1.2 – Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

4.2.2 – Internal Leakage

4.2.2.1 – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

4.2.2.2 – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

4.2.2.3 – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

4.2.3 – Cylinder Fails to Move the Load

4.2.3.1 – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

4.2.3.2 – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

4.2.3.3 – Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

4.3 Erratic or Chatter Operation

4.3.1 – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

4.3.2 – Cylinder sized too close to load requirements – Reduce load or install larger cylinder.

4.3.3 – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by the Company's certified facilities. The Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

Offer of Sale

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, Hydraulics Group, and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. Terms and Conditions. Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is expressly conditioned on Buyer's assent to these Terms and Conditions and to the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional term or condition of Buyer's order or any other document issued by Buyer.

2. Price Adjustments; Payments. Prices stated on the reverse side or preceding pages of this document are valid for 30 days. After 30 days, Seller may change prices to reflect any increase in its costs resulting from state, federal or local legislation, price increases from its suppliers, or any change in the rate, charge, or classification of any carrier. The prices stated on the reverse or preceding pages of this document do not include any sales, use, or other taxes unless so stated specifically. Unless otherwise specified by Seller, all prices are F.O.B. Seller's facility, and payment is due 30 days from the date of invoice. After 30 days, Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon tender to the carrier at Seller's facility (i.e., when it's on the truck, it's yours). Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's changes in shipping, product specifications or in accordance with Section 13, herein.

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of eighteen months from the date of delivery to Buyer. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

6. LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.

7. Contingencies. Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

8. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

9. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

10. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

11. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

12. Improper Use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

13. Cancellations and Changes. Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

14. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

15. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of the agreement. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

16. Waiver and Severability. Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

17. Termination. This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (c) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (d) an assignment for the benefit of creditors, or (e) the dissolution or liquidation of the Buyer.

18. Governing Law. This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

19. Indemnity for Infringement of Intellectual Property Rights. Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

20. Taxes. Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of Products.

21. Equal Opportunity Clause. For the performance of government contracts and where dollar value of the Products exceed $10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.

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